

Lawn R J & Brun W A. Symbiotic nitrogen fixation in soybeans. I. Effect of photosynthetic source-sink manipulations. *Crop Sci.* 14:11-16, 1974.
[Dept. Agronomy and Plant Genetics, Univ. Minnesota. St. Paul, MN]

Measurements using the acetylene-reduction assay showed that nitrogen fixation in nodules of field-grown soybeans declined early in the pod-filling stage. This decline was either delayed or advanced by treatments designed to respectively enhance or reduce the photosynthetic source-sink balance of the plants at this stage. [The SCI® indicates that this paper has been cited in over 140 publications since 1974.]

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I recall that Bill Brun admonished me for "skating on the edge of a teleological cesspool" during our first discussion on the role of host plant physiology in the control of nitrogen fixation. That was my second shock on transferring from the subtropics of the Southern Hemisphere to Minnesota in late January. I was there to work for Brun as a graduate research assistant whilst pursuing my higher degree studies.

Despite this somewhat inauspicious start, we soon found common ground, and by the end of May 1971, the experiment reported in this paper was sown. The work was initiated in an attempt to breach the "yield barrier," which was apparently preventing soybean breeders and agronomists from making advances comparable with those then occurring with the cereals.

The obvious difference between the cereals and soybean was the latter's high requirement for nitrogen. Yet we had preliminary evidence from studies in both the Midwest, and Queensland that nodule senescence was

often occurring, rather paradoxically, at the very time when needs for nitrogen assimilation were greatest. Thus arose our hypothesis that the developing pods were effectively reducing the supply of photosynthates to the nodules, a hypothesis that we tested by manipulating either the size of the photosynthetic source or the pod sink.

Conceptually, the experimental procedures were simple, but their application in the field posed some logistical problems. For example, the supplemental lighting required nearly 40 amps, which, combined with the needs of other students, exceeded existing supply. The solution was to divert nearby additional power via underground cable, a task we students confidently undertook one Saturday afternoon. It was the following Wednesday that the appearance of a North-Western Bell tent near our plots revealed an association between our handiwork with the trench-digger and the simultaneous malfunction four days earlier of 200 campus telephones.

There are, no doubt, several reasons the paper has been frequently cited, but an important one is that it focussed attention on several points: the importance of the physiology of the host plant, particularly its energy supply; the productivity of the symbiosis; and the potential limitations to yield. It also exemplified how the then-novel¹ and untarnished acetylene-reduction assay might be used to examine the short-term responses of the symbiosis. In recent years, the focus of researchers' attention, including that of my coauthor,² has shifted to the role of host plant hormones in the regulation of assimilate partitioning.

Some recent research in Australia has again raised my interest in the relationships between carbon supply, nodule function, senescence, and nitrogen assimilation. By growing soybeans in saturated soil,³ we have been able to minimise water stress, maximise growth, sustain nitrogen fixation during podfill, delay senescence,⁴ and push experimental yields to greater than 8.5 t.ha⁻¹.

1. Hardy R W F, Holsten R D, Jackson E K & Burns R C. The acetylene-ethylene assay for N fixation: laboratory and field analysis. *Plant Physiol.* 43:1185-207, 1968. (Cited 790 times.)
2. Helndl J C, Carlson D R, Brun W A & Brenner M L. Ontogenetic variation of four cytokinins in soybean root pressure exudate. *Plant Physiol.* 70:1619-25, 1982.
3. Troedson R J, Garside A L, Lawn R J, Byth D E & Wilson G L. Saturated soil culture—an innovative water management option for soybeans in the tropics. *Proceedings of the First International Symposium on Soybeans in Tropical & Subtropical Cropping Systems*. Tsukuba, Japan, 1983.
4. Nathanson K, Lawn R J, DeLobrun P L M & Byth D E. Growth, nodulation, and nitrogen accumulation by soybeans in saturated soil culture. *Field Crop. Res.* 8:73-92, 1984.